Methane cycling in the alkaline serpentinizing vents of the Prony Hydrothermal Field, New Caledonia

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Both experimental and empirical data indicate that H_2 generated by serpentinization can combine with carbon to abiotically form CH_4, with clear implications for abiogenesis. Today, CH_4 is both generated and consumed by microbes, complicating our determination of abiotic versus biotic sources. Here, we present new isotopic data for the unique, serpentinite-hosted, *shallow-sea* alkaline hydrothermal vent system; the Prony Hydrothermal Field (PHF), offshore New Caledonia (supplementing [1]). Besides low salinity, H_2O isotopes confirm that all fluids are sourced from meteoric water. Free gas H_2 and CH_4 concentrations were up to 40 and 16%, respectively, with the remainder as N_2. δD-H_2 values (-684 to -725‰) suggest equilibrium with H_2O at temperatures in the range of 30-60°C. The δ^{13}C-CH_4 varied ~10‰ between each site, with increasing ^{13}C enrichment from Kaori (-38‰), Japonais (-24‰), and Aiguille (-16‰). The δD-CH_4 values were around -292‰ for Kaori, -324‰ for Japonais, and -281‰ for Aiguille. δ^{13}C-CH_4 values are all within the range of abiotic formation via FTT synthesis, but such enrichment could also mean variable imprint of CH_4 oxidation on biogenic CH_4 (e.g., [2]). At PHF, two phylotypes of uncultivated Methanosarcinales dominate the archaeal community [3, 4, 5], each previously detected only at The Cedars (California) and the Lost City Hydrothermal Field. It is unclear if these Methanosarcinales thrive by methanogenesis, methanotrophy, or both, but it is likely that isotopic signatures are influenced by these and other microbial interactions. [1]*Monnin et al. (2014), Biogeosciences, 11 5687-5706.* [2]*McKay et al. (2016), Env. Mic. Reports, 8, 150–161.* [3]*Quéméneur et al. (2014), Env. Mic. Reports, 6, 665-674.* [4]*Postec et al. (2015), Frontiers in Microbiology, 6, 857.* [5]*Frouin et al. (2018), Frontiers in Microbiology, 9, 102*